MODULE 5 - VIRUSES

Objectives

No BETC test questions are from this module EXCEPT for the section on control of viral foodborne illness.

On completion of this section, participants will be able to:

- Discuss the major differences between bacteria and viral foodborne agents.
- Identify the important routes and agents of foodborne transmission.
- Identify the important foodborne viruses.
- Discuss the control of viral foodborne illness.

Introduction

Unlike bacteria, viruses are not alive. Viruses are much smaller than bacteria and consist of a protein coat, which encloses a nucleic acid core. They are what are called "obligate intracellular parasites". The virus attaches to a susceptible cell and injects its nucleic acid into the cell. It takes over the host cell producing millions of new viruses and destroys the cell in the process. Viruses only infect a particular type of cell in a particular species of animal. So the ones we have to worry about only infect human beings. Only a small number are needed to make someone ill.

When viruses are in a food, they are simply there and do not replicate or increase in number. Viruses are extremely persistent and may remain in a contaminated food for long periods of time. To increase the number of virus particles to make them easier to detect, you have to grow them in a susceptible host cell. Currently, there are no susceptible host cells other than humans for the viruses associated with foodborne illness so detection is difficult.

Foods are contaminated with viruses in four major ways:

- Contaminated Estuarine Water
- Contaminated Irrigation Water
- Contaminated drinking water
- Poor Personal Hygiene

Sewage-polluted estuarine waters can contaminate fish and shellfish. Oysters, clams and mussels, which are filter feeders, entrap the

pathogens from the water in their mucous membranes and transfer them to their digestive tract. If the shellfish is consumed whole and raw, so are the viruses. The surfaces of other estuarine species can also get contaminated but most of these are not consumed raw. In order to be a problem, they must be recontaminated after cooking by use of equipment or utensils that had been contaminated through contact with raw seafood or infected employees.

Contaminated irrigation water can deposit viruses on the surface of fruits and vegetables. Again, it is generally foods that are consumed raw that are of concern.

Viruses can be introduced if contaminated drinking water is used to wash or transport food, or is used as an ingredient in the food, or if you just drink it.

Viruses can be added to food by infected food handlers with fecal material on their hands, a result of poor personal hygiene practices. Sometimes such people are noticeably ill, but other times they are without symptoms, and are just carriers of the virus. Ready-to-eat products such as bakery and deli items are of particular concern but virtually any food may cause illness if it is contaminated with human fecal matter containing the virus.

The viruses of interest for Public Health Environmentalists are:

- **Hepatitis A virus** http://vm.cfsan.fda.gov/~mow/chap31.html
- **Hepatitis E virus** http://vm.cfsan.fda.gov/~mow/chap32.html
- **Rotavirus** http://vm.cfsan.fda.gov/~mow/chap33.html
- **Norwalk virus group** http://vm.cfsan.fda.gov/~mow/chap34.html
- **Other viral agents** http://vm.cfsan.fda.gov/~mow/chap35.html

VIRUSES AND SHELLFISH

Pathogenic viruses that enter shellfish waters tend to accumulate in sediments, where they can persist for months. They survive better at lower, winter temperatures, which is when most of the shellfish are harvested for human consumption. Pathogenic viruses have been isolated from both "opened" and "closed" waters, and from shellfish harvested from each. Once taken in by shellfish, the viruses may persist for months. Illegal harvesting of shellfish from unapproved waters may exacerbate the problem of shellfish-borne viral illness.

In clean seawater, contaminated molluscan shellfish naturally eliminate pathogens from their digestive tracts through normal feeding, digestion, and excretion. In a process called relaying, shellfish from contaminated waters are transferred to clean waters where they filter feed for a

predetermined period of time to eliminate bacteria and viruses from their systems. In depuration, shellfish are placed in tanks with purified flowing water or recirculating seawater and are allowed to filter-feed. Depuration conditions are closely controlled so the process usually takes two to three days, while relaying can take two or more weeks. Generally, the removal of viruses takes longer than removal of bacteria. So, elimination of bacteria is not a reliable indicator of viral elimination.

Control of Viruses

Both Hepatitis A virus and the Norwalk agent are resistant to extremes of pH and are extremely stable at both refrigeration and freezing temperatures. There appears to be resistance to heat and radiation treatments as well. Most control measures have been evaluated in shellfish only. One interesting note is that shellfish tissue is quite protective and therefore pathogenic viruses are fairly heat resistant there.

Transmission of human viral disease by consumption of cooked shellfish has been documented epidemiologically. Hepatitis A virus is still infective when treated at 133° F for 30 minutes in shellfish. Cooking conditions such as frying, steaming, baking, and stewing result in only a ten-fold reduction of viruses. Heat treatments necessary to completely inactivate viruses in shellfish generally result in a product that is organoleptically unacceptable. Other products that are heated to temperatures of 180°F should be free of the virus.

On the other hand, chlorine is an effective agent to inactivate these viruses in waters, provided the water is relatively clear prior to chlorination.

Control of viruses:

- Clean shellfish water
- Clean irrigation water
- Clean drinking water
- Proper hygienic practices by food handlers

The most effective control for viruses is preventing contamination of food products in the first place. Shellfish must be harvested from waters that are not contaminated by sewage. Crops must not be irrigated with fecal contaminated water. Drinking water must be from a safe source, or properly treated. And employees must conform to hygienic practices.

Vaccination for HAV is available to the general public. It has been suggested that HAV vaccination be required of all food handlers. Passive immunization with gamma globulin following exposure to HAV or in anticipation of possible exposure continues to be done. However this must

occur in a timely manner. It does not provide immunity. It is expensive, and there are difficulties in identifying all exposed individuals. Norwalk and SRSV's immunity is temporary and vaccination efficacy will most likely be limited.

References

Jaykus, Lee-Ann. 1997. "Viruses", Food Microbiological Control. FDA